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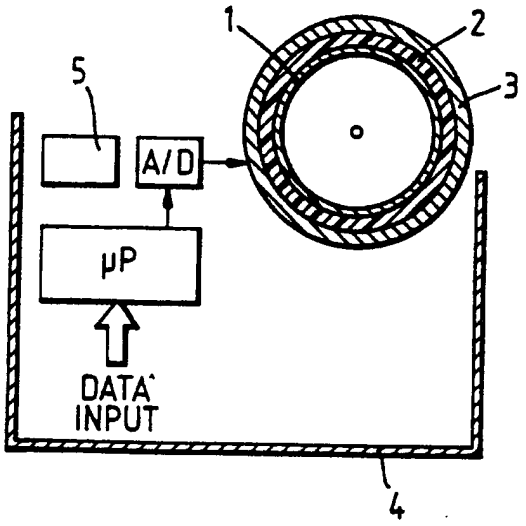
(54) Title: PRINTING MEMBER




(57) Abstract

A printing member such as a metal cylinder (1) incorporates a photopolymer (2) as a light-sensitive medium. In a process for preparing the printing member, the photopolymer (2) is coated with a secondary photosensitive layer (3). In one example this is a photographic emulsion of the type commonly used for lithography. The secondary light-sensitive layer is exposed using a digitally modulated light source. The light source is scanned with respect to the printing member. Subsequently the secondary photosensitive layer is developed and then the photopolymer is exposed through the developed secondary photosensitive layer.

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# PRINTING MEMBER

## BACKGROUND TO THE INVENTION

The present invention relates to the preparation of printing cylinders or other printing members, and in particular to printing cylinders incorporating a photopolymer surface.

Printing cylinders are commonly prepared by controlled exposure of a photosensitive medium on the cylinder surface. For example, in screen printing a screen typically made of a perforated cylindrical nickel sleeve is coated with a photosensitive lacquer covering the entire screen and filling all the perforations. Portions of the photo-sensitive lacquer are then exposed to ultraviolet light through a photographic negative and are subsequently developed. In the development process, where the lacquer has not been exposed to the ultraviolet light it is removed to open the perforations in the screen, producing the required pattern of ink transmitting areas.

It is known, particularly where the cylinder is to be used for flexographic or gravure processes, to use a photopolymer as the photosensitive medium. EP-A-197601 discloses a method of preparing a printing roller in which the photopolymer medium is covered by a light-sensitive intermediate layer. In a first stage, a patterning film is applied to the roller and the intermediate layer is exposed through that film. The intermediate layer is then developed before a subsequent stage in which the photopolymer layer is exposed through the intermediate layer.

Since the intermediate layer in such a system is seamless, and is fixed in register with respect to the photopolymer medium, it potentially offers considerable advantages in preparing cylinders for such uses as the printing of continuous patterns. However, in practice, many of these potential advantages have been obviated by

problems associated with the patterning film used to expose the intermediate layer in the first stage. As described in the above cited application, if the patterning film is positioned on the cylinder with abutting edges then light tends to be scattered or reflected at the edges, resulting in incomplete light transmission and a resulting discontinuity in the exposed pattern. On the other hand, if the film is positioned with its edges overlapping that also changes the effective density of the negative, and hence the amount of light transmitted in the overlapping region and may also cause physical distortion of the light-sensitive media.

## SUMMARY OF THE INVENTION

According the present invention, a process for preparing a printing member incorporating a photopolymer as the light-sensitive medium, comprises providing the photopolymer with a secondary light-sensitive layer, exposing the secondary light-sensitive layer with a digitally modulated light source which is scanned with respect to the member, developing the secondary light-sensitive layer, and subsequently exposing the photopolymer through the developed secondary light layer.

Although directly digitally modulated light sources have previously been used for such purposes as preparing perforated cylindrical nickel printing sleeves, it has not previously been thought possible to use such techniques with photopolymers of the type used for flexographic processes. In general, such media cannot be exposed at the wavelengths and intensities normally available from directly modulated sources such as lasers. However the present inventors have found that by combining the use of a modulated light source with the provision of an intermediate light-sensitive layer digitally controlled exposure of the photopolymer is possible in a manner which overcomes the disadvantages of the prior art systems requiring the use of a patterning film. Thus by exposing

the intermediate layer while modulating a scanned light source with appropriate digital data it is possible to generate a perfectly continuous pattern with no discontinuities. The method is therefore particularly advantageous for the production of continuous image rollers for packing, decorative, wall covering and similar products. For such purposes, a pattern formed from multiple repeat units may be formed from a single digital original, removing the need for step and repeat photographic methods. Moreover, by contrast with the prior art processes requiring the use of a separate patterning film, the cylinder can be produced more quickly using a single integrated process with fewer handling steps.

Preferably the secondary light-sensitive layer is a photographic emulsion or a photo-resist. More preferably the layer is a lithographic photographic emulsion for bright light or yellow light working.

## A BRIEF DESCRIPTION OF THE DRAWINGS

A process in accordance with the present invention will now be described in detail with reference to the accompanying drawings in which:

Figure 1 is a cross section through a printing cylinder;

Figure 2 is a diagram showing the cylinder installed in an exposing unit; and

Figures 3A to 3G are diagrams illustrating schematically the different steps of one example of the process.

## DETAILED DESCRIPTION OF EXAMPLES

The printing cylinder comprises a metal cylinder 1 coated uniformly on its surface with a photopolymer 2. The photopolymer may, for example, be that manufactured by Dupont as CYREL type HLS. The photopolymer may be applied in a conventional fashion using apparatus such as that commercially available from Stork Limited and sold under

the trade name SEAMEX SLEEVES. The cylinder is subsequently coated with a secondary photosensitive layer 3 which, in this first example, is a photographic emulsion of the rapid access type designed for lithography and which is suitable for either bright light work or yellow light working. Once the emulsion coated on the photopolymer has dried the cylinder is mounted in an exposing machine 4. In construction the exposing unit is generally similar to the rotary colour output scanners widely used in the industry and commercially available from manufacturers such as Hell or Dai Nippon. The exposing head incorporates a low power light source 5. The output of the light source 5 is modulated via a digitally controlled electro-optic or acousto-optic modulator to produce the desired image on the photographic emulsion. To reduce the time taken for exposure, multiple exposure heads may be used.

Once the photographic emulsion has been exposed, the cylinder is removed and processed in a modified photopolymer exposure unit. The modifications, by comparison with a conventional photopolymer processor, consist of the addition of an in-line photographic processor which develops, fixes, hardens and dries the image in the photosensitive layer 3 on the surface of the photopolymer. Subsequent stages in the exposure and processing of the cylinder are then carried out conventionally, using an ultraviolet light source to expose the photopolymer through the developed secondary photosensitive layer 3. The unexposed areas of the photopolymer are then washed out and the cylinder dried.

In an alternative embodiment using a photographic emulsion, the emulsion, which as in the embodiment discussed above, is a lithographic photographic emulsion for bright light or yellow light working, is not applied directly to the photopolymer but instead is applied to a transparent substrate which, in this example, is a tube 6 of clear plastics material such as polyvinylidene chloride.

The tube of plastic is pre-stressed in manufacture to enable it to shrink on the application of heat.

The process of this embodiment is illustrated schematically in Figures 3A to 3G. After the clear plastics tube 6 has been fitted over the photopolymer coated cylinder 1 it is heated using hot air from a source 9 to shrink the tube. As seen in Figure 3B, more shrinking occurs away from the cylinder. In this and the other figures the separation of the substrate from the cylinder is exaggerated for the sake of clarity: in reality after shrinking the tube makes a close fit with the surface of the cylinder. After the substrate has been fitted to the cylinder it is coated with the photographic emulsion 7 using a dip bath as shown in Figure 3C. Other methods may be used to apply the emulsion, including spraying or spreading. The cylinder is subsequently removed from the bath and the emulsion coated on the substrate dried in a forced air flow. The cylinder is then mounted in an exposing unit 4' and exposed in the same manner as described above in relation to Figure 2. The exposed cylinder is then placed in a secondary development station 8 to develop and fix the photographic emulsion as shown in Figure 3E. In the next stage, the photopolymer 2 is exposed through the developed photographic emulsion. The plastics substrate 6 bearing the emulsion is then cut away from the cylinder and the cylinder with the exposed photopolymer placed in a photopolymer development and fixing station 10 for processing in a conventional fashion.

Although it is preferred that the plastics tube should be shrink-fitted to the cylinder prior to the application of the photographic emulsion, alternatively the emulsion may be applied to the plastics tube before it is fitted to the cylinder.

In an alternative embodiment, the secondary photosensitive layer is a photo-resist of the type commonly used with gravure cylinders. The photo-resist is coated on the photopolymer 2 using techniques such as ring coating,

or bar coating, or any of a number of other techniques commonly used in applying photo-resist to gravure cylinders. The coated cylinder is then exposed in a similar process to that described above, but using a higher power light source such as an Ar ion laser. The exposing machine may incorporate a digitally modulated laser exposure head. A suitable head would be similar to that produced by "Think Laboratories" for their Laser Stream product.

After exposure, the secondary photosensitive layer is then developed, and the photopolymer exposed, as described above. The chemistry of the development process is modified as appropriate to the particular photo-resist used.

The present invention may be used, for example, for flexographic printing processes. Such processes commonly use photopolymers produced by BASF, DUPONT, and others. However hitherto it has not been possible to produce images in continuous form. The invention may also be used for gravure processes which at present use photopolymer in sheet form.

Although described above in relation to sleeves and cylinders the present invention is also applicable to flat plates for flexographic and gravure processes of the type discussed above.

## CLAIMS

1. A process for preparing a printing member (1) incorporating a photopolymer (2) as the light-sensitive medium, comprising providing the photopolymer with a secondary light-sensitive layer (3), exposing the secondary light-sensitive layer (3) with a digitally modulated light source which is scanned with respect to the member, developing the secondary light-sensitive layer (3) and subsequently exposing the photopolymer (2) through the secondary light-sensitive layer.

2. A process according to claim 1, in which the printing member (1) is a cylindrical printing member or sleeve.

3. A process according to claim 1 or 2, in which the secondary light-sensitive layer (2) is a photographic emulsion or photographic resist.

4. A process according to claim 3, in which the secondary light-sensitive layer (2) is a lithographic photographic emulsion for bright light or yellow light working.

5. A process according to any one of the preceding claims, in which the secondary light-sensitive layer is provided on a transparent substrate (6) fitted to the printing member (1) over the photopolymer.

6. A process according to claim 5 when directly or indirectly dependent on claim 2, in which the transparent substrate (6) is a pre-stressed plastics tube which is placed over the sleeve or cylinder and heated, thereby shrinking the tube to fit the cylinder or sleeve (1).

7. A process according to claim 5 or 6, in which the secondary light-sensitive layer (3) is coated on the transparent substrate (6) after the substrate is fitted to the printing member.

8. A process according to any one of claims 5 to 7, in which the substrate (6) is removed from the printing member (1) after the exposure of the photopolymer (2), the photopolymer subsequently being developed.

9. A system for preparing printing members comprising a printing member (1) carrying a light-sensitive photopolymer (2), and a secondary light-sensitive layer (3) adjacent the photopolymer, and

means (4, 5) for exposing the secondary light-sensitive layer comprising a light source, means to modulate the light source in response to digital printing data and means to scan the light source with respect to the printing member.

10. A system according to claim 9, in which the secondary light-sensitive layer (3) is formed on a transparent substrate (6) which is fitted to the printing member (1) over the photopolymer.

11. A system according to claim 10, in which the printing member (1) is a cylinder or sleeve and the transparent substrate (6) is a plastics tube shrink-fitted to the printing member.

Fig.1.

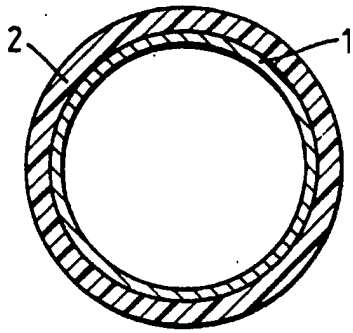



Fig.2.

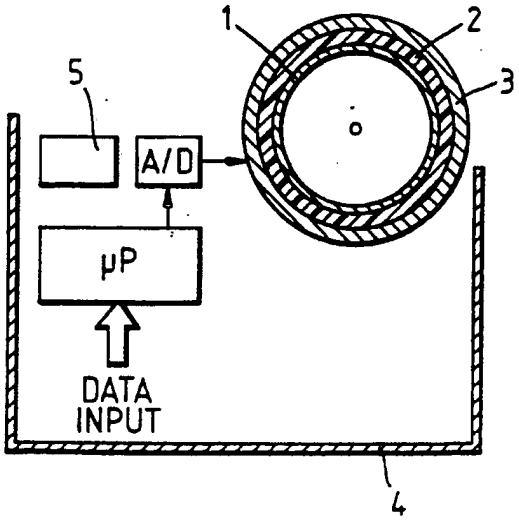


Fig.3A.

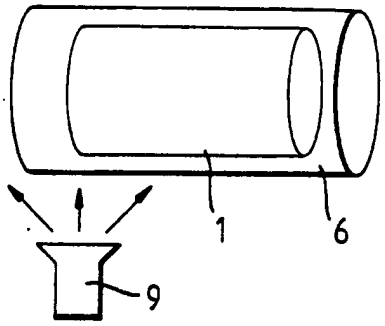



Fig.3B.

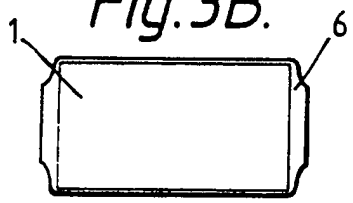



Fig.3C.

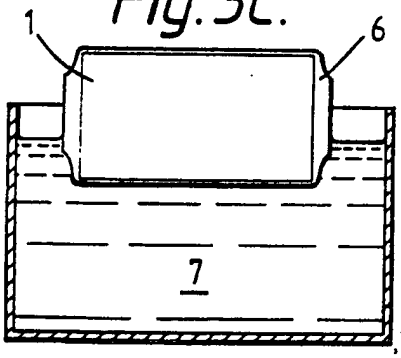



Fig.3D.

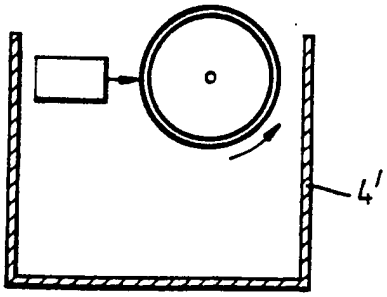



Fig.3E.

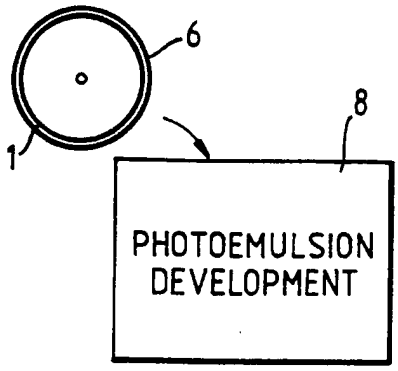



Fig.3F.

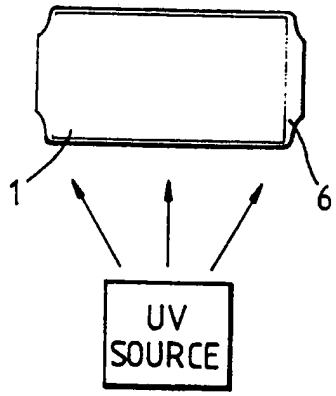
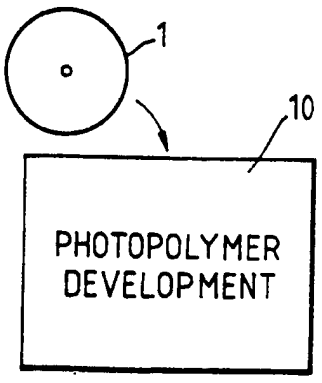



Fig.3G.



# INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 91/01234

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: G 03 F 7/095, 7/24, B 41 C 1/18

## II. FIELDS SEARCHED

Minimum Documentation Searched[7]

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| IPC5 | B 41 C; G 03 C; G 03 F |

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

## III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

| Category * | Citation of Document,[11] with indication, where appropriate, of the relevant passages[12] | Relevant to Claim No.[13] |
|---|---|---|
| Y | US, A, 4232345 (PETER M. ZOLLMAN ET AL) 4 November 1980, see claim 1 -- | 1-2,9 |
| Y | EP, A2, 0182332 (HEWLETT-PACKARD COMPANY) 28 May 1986, see page 8, line 10 - line 35; figure 3; claims 1,8 -- | 1-2,9 |
| A | WO, A1, 9006234 (STORK SCREENS B.V.) 14 June 1990, see claim 1 -- | 1-2,9 |
| A | EP, A2, 0251059 (HOECHST AKTIENGESELLSCHAFT) 7 January 1988, see page 2, line 6; page 2, line 28 - line 30; page 2, line 36 - line 37 -- | 1-2,9 |

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## IV. CERTIFICATION

| Date of the Actual Completion of the International Search | Date of Mailing of this International Search Report |
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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

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| A | GB, A, 1529590 (LEATHLEY PUBLICATIONS LIMITED) 25 October 1978, see page 1, column 13 - column 14 | 1-2,9 |
| A | EP, A1, 0197601 (STORK SCREENS B.V.) 15 October 1986, see page 6 - page 7, especially page 6, line 20 - line 25; figure 1 | 1-11 |

# ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/GB 91/01234

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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